The role of EEGs in the treatment and prognosis of epilepsy

For example, a study by Boylan et al (2002) to assess the effectiveness of phenobarbital in neonates showed that where the background EEG was normal phenobarbital was likely to be ineffective as a first antiepileptic.

When in status epilepticus, some patients are paralysed and need to be ventilated. In this circumstance, we need to know if the treatment is working or not. The EEG may be the only clue as to whether the seizure activity is continuing or the treatment is having an effect (Fowle and Binnie, 2000).

But this is only one example and other studies suggest that the usefulness of the EEG in determining the effectiveness of treatment could be questioned. When compared with a placebo, sulthiame monotherapy (which is not licensed in the UK but available on a named-patient basis) was found to have a marked effect on the EEG in benign childhood epilepsy with centrottemporal spikes (BECTS). However, the authors of the study cautioned that normalisation in the placebo group reflects a wide spectrum of individual courses that need to be considered when analysing drug effects on EEG in BECTS (Bast et al, 2003).

The EEG might also be helpful in deciding whether to start treatment in the first place. One school of thought is that in first unprovoked seizures it is better to defer treatment unless it is a remote symptomatic seizure associated with definite epileptiform abnormalities on EEG (Madhusudanan, 2000).

Others make similar suggestions but add further criteria. For example, in a study to predict the risk of recurrence after a single unprovoked idiopathic seizure, Das (2000) says that in order to be able to say recurrence is less likely not only are a normal EEG and computerised tomography (CT) scan needed, but also that more than three months should have passed since the last seizure.

In the context of surgery and the management of epilepsy, the EEG is a useful tool when it is used in conjunction with other available information (Shaefi and Harkness, 2003). In a review of literature, the researchers found that significant clinical improvement could be achieved in up to 80 per cent of cases of mesial temporal sclerosis when all results were in agreement including EEG, neuropsychological and neuropsychiatric results.

Studies and the understanding and relevance of the findings as regards treatment are at an early stage. Valentin et al (2002) carried out a study to investigate in-vivo cortical excitability in the human brain. The patients in the study had refractory epilepsy with subdural or intracerebral electrodes implanted for assessment prior to surgery. Cortical responses were compared with single-pulse stimuli in areas where seizure onset occurred, with responses recorded elsewhere.

Two main types of response were identified:

- Early responses;
- Delayed responses.

The early responses were seen in most areas but the delayed responses were found to be associated with areas where the seizure onset occurred.

It was thought that the studying of delayed responses might improve understanding of the physiology and dynamics of neuronal circuits in epileptic tissue and possibly have a clinical application in the assessment of candidates for surgery.

Surgery

Surgery depends largely on accurately identifying the area of the brain where the seizure begins. An example of how the EEG is proving to be very effective in this is a study carried out by Alarcon et al (2001). The study looked at the value of scalp recordings to localise and lateralise seizure onset in temporal lobe epilepsy. This was done by comparing simultaneous scalp and intracranial foramen ovale (FO) recordings during presurgical assessment. It was found that a bilateral scalp onset is compatible with a mesial temporal onset and should not be a deterrent to surgical assessment.

A unilateral scalp onset at T1/T2 or T3/T4 (Fig 1) is associated with a higher probability of mesial temporal onset. A unilateral response at other electrodes is less likely to be associated with a mesial temporal onset. It was also found that the presence of clinical manifestations preceding the scalp onset does not reduce the localising or lateralising values of scalp recordings.

Vagal nerve stimulation

A relative newcomer to treatment in epilepsy is vagal nerve stimulation (VNS). It is used in the treatment of refractory epilepsy and is believed to originate from the idea that since VNS can alter the EEG it just might influence epilepsy. Whatever treatment is used, biji medica tion or surgery, what we really want to know is how effective it is.

Progress

Determining what progress is being made could involve simply waiting to see if the person has further seizures. While this may be enough in most circumstances, in others we need to know if the patient still has an abnormal EEG or is having what is sometimes referred to as a subclinical seizure.

If during status epilepticus, the patient is ventilated and paralysed there is a need to know if the seizure activity is continuing or if the treatment is having an
that an EEG reading can be abnormal in people who do
not have epilepsy and normal in people who do.

The significance of what is recorded in an EEG can be
easily misunderstood or misinterpreted. A meta-analysis
of EEG test performance concluded that there was a wide
variation in the interpretation of EEGs (Gilbert et al,
2003). This makes it difficult to use the EEG as a reliable
predictor of seizure recurrence.

The use of EEGs
The reason for requesting an EEG should always be clear.
If, as in many cases, an EEG is being carried out simply to
calculate the diagnosis of epilepsy, health professionals
should be aware that in adults with epilepsy 50 per cent
of initial EEG recordings will be normal (Blume, 2001).

Classification of seizures and syndromes
In light of these areas of potential ambiguity it might be
more appropriate to think of the EEG as a means of clas-
sifying seizures and epilepsy syndromes rather than as a
diagnostic tool.

With a classification of a particular syndrome, we can
calculate or address the issues of severity, treatment,
progress and the prognosis. For instance, in syndromes
such as juvenile myoclonic epilepsy it is now possible to
give the patient some idea of how the condition may
develop, what the prognosis is and what treatment has
been found to be most effective.

Hopefully we will begin to develop a clearer under-
standing of how EEGs can be used. If it is not a diagnostic
tool for epilepsy then perhaps its role in assessing the
severity, treatment, progress and prognosis of the condi-
tion should be explored further.

Assessing severity
The likely severity of the condition is based on our
knowledge and understanding of the different epilepsy
syndromes. Therefore, the first question should be what
type of epilepsy is it?

The International League Against Epilepsy (ILAE) classi-
sifies both epileptic seizures and epilepsy syndromes. The
definitions for both include clinical and electrographic
features. In fact, some would see classification as the
most valuable use of the EEG (Fowle and Binnie, 2000).

The link between electrographic and clinical features is
worthy of note, although there is a little way to go
before we can use only the EEG as an assessment tool.

Attempts have been made to look at the use of the EEG
in predicting the severity of epileptic seizures
(Panayiotopoulos, 1999). In early-onset benign child-
hood occipital seizures (EBOS) it was found that the EEG
was not useful in predicting the clinical course or the
severity of the syndrome.

Evaluating the efficacy of treatment
Evidence regarding the use of the EEG in assessing the
efficacy of treatment is much more readily available.
Treatment in most cases involves either medication or
surgery. In the case of medication this involves deciding
which medication to use.

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effect. In this situation, the EEG may be the only indicator of the progress being made in the patient’s treatment (Fowle and Binnie, 2000).

**Prognosis**

The role of the EEG with regard to prognosis also depends somewhat on the classification of epilepsy syndromes (Fowle and Binnie, 2000). However, bearing this in mind the EEG can help us provide the patient with some idea of the likely prognosis for his or her condition.

One of the most worrying times for parents is when their child has febrile convulsions. In one small study, Pressler et al (2001) performed a series of early EEGs in infants with hypoxic ischaemia encephalopathy and compared the findings with neurodevelopmental outcome. It was found that early EEG is an excellent prognostic indicator. A normal EEG within the first eight hours of life indicated a successful outcome, while a poor outcome was indicated if background activity continued to be inactive or grossly abnormal beyond eight to 12 hours of life.

On the other hand, an inactive or very depressed EEG within the first eight hours of life can have a good outcome if the EEG activity recovers within 12 hours. This was a small study but it does indicate that the EEG may have an important role to play in the prognosis of at least one condition.

Adult patients who have had a single seizure are understandably keen to know their likelihood of having further seizures and a diagnosis of epilepsy. It has been found that patients who have a single unprovoked idiopathic seizure with a normal CT scan are less likely to have a recurrence, especially if:

- The duration of the seizure is short;
- The EEG is normal;
- More than three months have passed since the first seizure occurred;
- Treatment has been started.

A family history of epilepsy was found to be of moderate significance (Das et al, 2000).

When a person has recurrent seizures and, therefore, a diagnosis of epilepsy Fowle and Binnie (2000) contest that it is unnecessary to have an EEG examination as in most cases it will offer no new information unless the seizure type or frequency has changed significantly.

**Surgery**

It is not only the prognosis for newly diagnosed patients that is a consideration. EEGs can also be relevant for those who are being offered the chance of surgery.

Following a temporal lobectomy there are several factors that contribute to a favourable outcome (Hennessy et al, 2001). The factors that appear to give the most favourable outcome are:

- Interictal EEG localisation to the operated lobe;
- The absence of secondarily generalised seizures.

Considering these factors might aid the presurgical assessment of patients with intractable temporal lobe epilepsy and cases where neuroimaging shows evidence of mesial temporal sclerosis.

**Medication**

Once the trauma of having been diagnosed with epilepsy is over and medication has been prescribed, many patients want to know if or when they can stop taking medication. It would appear that the EEG can help in deciding this, but it is not a reliable predictor of outcome. However, while the presence of epileptiform activity after the discontinuation of treatment does not in itself necessarily influence prognosis, certain types of activity such as irregular generalised spike-waves signal a high risk of relapse (Andersson et al, 1997).

**Conclusion**

As yet there is no diagnostic tool for epilepsy. It was hoped by many that the EEG would fill this void but its efficacy has not been proven. So what clinical value does it have? There appear to be many possible uses of the EEG but no clear agreement on its best use. Its role in assessing treatment, severity, progress and prognosis is variable. While it is useful as part of a toolkit it does not on its own give a clear, definitive answer to any of the questions posed.

Patients now have much more access to information and so know what is available. The EEG has been latched on to as a test that all patients suspected of having epilepsy should have. In practice this is not the case and the results can be misleading for both the patient and the clinician.

In other words, there is a difference between what patients and health professionals want to know and what the EEG can actually tell them. The EEG is only a single tool and in most cases is not used on its own to provide the answer. The need to find answers to questions around areas such as severity, treatment, progress and prognosis seems to be detracting from the area that the EEG can provide most help in – the classification of